Tackling Mushroom Disease Control In An Environmentally Conscious World

DR. HELEN GROGAN | Horticulture Development Department, Teagasc Food Research Centre | Ashtown, Dublin, Ireland

The mushroom industry, like all of agriculture worldwide, is facing the impact of climate change as well as consumers' desires to address it though modifying what they purchase so as to be as environmentally friendly as possible. At the 2021 ISMS Congress, Dr. Helen Grogan presented the state of the changing climate and opportunities for Integrated Pest Management in the mushroom industry.

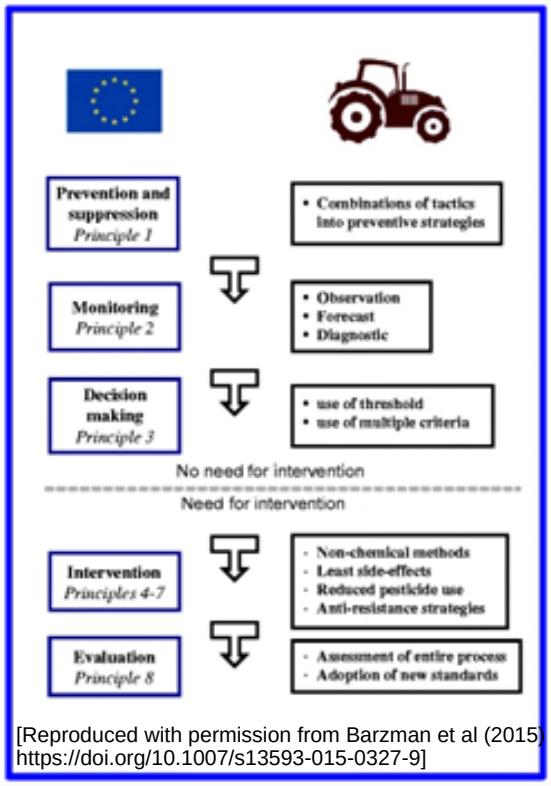
There are existing positive aspects regarding the environmental sustainability of mushroom production: agricultural waste streams are recycled (straw/manures); alternative energy sources are widely used; spent substrate is returned to the land as a soil amendment; and modern growing practices involve low pesticide usage. However, we have to do more.

Sustainability must be made front and center for all our activities. Sustainable energy sources and green transport options must be assessed and adopted wherever possible. Alternative packaging that is compostable and/or plastic-free is in development and should be invested in. Integrated Pest Management (IPM) strategies should be adopted to reduce dependence on chemical pesticides that are harmful to the environment. Peat alternatives in casing should be developed and invested in. All this will lead to more sustainable & healthy food production systems with reduced carbon footprints, and should be adopted as major goals of the industry.

Integrated Pest Management

Integrated Pest Management is a key element to sustainable and healthy mushroom production. IPM emphasises "the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms." Agricultural researchers and advisors across Europe have identified eight principles of IPM, which serve as guidelines on how to achieve this (Barzman et al. (2015) *https://doi.org/10.1007/s13593-015-0327-9*)

EU IPM PRINCIPLES



[Reproduced with permission from Barzman et al (2015) https://doi.org/10.1007/s13593-015-0327-9]

Principle 1: Prevention

Good crop management is the first line of defense in preventing disease. Key factors include: good quality substrates, clean buildings and equipment, automated filling and casing, and continuous good hygiene levels involving cleaning, disinfection and steam.

Disease resistant strains can aid disease prevention but developing disease resistant strains is complicated for many reasons. New mushroom strains would need to retain commercially-desirable traits as well as any resistance traits. Wild mushroom populations may harbour disease resistance traits but they are often not commercially acceptable however, they can be used in mushroom breeding programs. The industry must also accept and continually prepare for the fact that absolute resistance is not feasible and that new pathogens may emerge.

Principle 2: Monitoring

Simply put, growers must be committed and consistent in observing crops daily and recording information on disease occurrence, including diagnostics if necessary to confirm the identity of the pathogen of concern.

Principle 3: Decision Making

Decision making has to be based on the records of disease incidence to identify the correct corrective action: Records and patterns will assist the grower in deciding what to treat, when to treat, and with what. Clean crops should not need any intervention while diseased crops will. Again, records need to be kept of the treatment and results, as this can help when reviewing disease incidence later.

Principle 4: Consider Non-Chemical Methods First

Many non-chemical methods are available to help control diseases such as:

- Spot treatment of disease: this must be done carefully and well
- Manage people movement
- Stop after two flushes
- Stop watering between flushes
- Steam cook-out

When possible, use biological control agents. Research continues to generate information on biological controls for the industry but there are still challenges. Some commercial products are available such as:

- Serenade, Serifil, Amylo (*Bacillus* based products)
- Zivion (Natamycin),
- SporeKill (long chain fatty acids)

However, efficacy data is scarce or weak. Efficacy trials using Serenade for the control of dry bubble, wet bubble, and cobweb disease under high disease pressure gave poor levels of control (Pyck et al, unpublished) and it may be that the model for testing product efficacy must change when working with biological agents or there may be merit in combining a number of products together Barzman et al (2015) stated, "We need to look at possible synergies from combining alternative methods compared to each one individually."

Principle 5: Careful Selection of Chemical Pesticides (Fungicides)

The chemical fungicides currently approved for use in mushroom production are harmful and toxic and should be used with due care and diligence. The guiding principles are:

- Choose the least toxic (though there may not be much choice)
- Understand that many are dangerous for the environment and human health
- Pesticide use can result in chemical residues in food, which must be below the Maximum Residue Level (MRL) permitted for that pesticide. Exceedances do occur if products are incorrectly applied
- Pathogens may be resistant or can develop resistance with continued use.

Principle 6: Minimize Pesticide Use

This is one of the key principles of IPM and pesticides should only be used when needed. Using pesticides routinely in the absence of disease is a waste of money and can also hide the true levels of disease on a farm.

Principle 7: Anti-Resistance Strategies (Fungicides)

Pests and pathogens can learn to live with pesticides, especially if used continuously, and resistant strains can emerge that are no longer affected by the chemical. This can happen relatively quickly sometimes so the best advice is to alternate products with different modes of action and only use them when needed.

Principle 8: Evaluate the Process and Adopt a New Approach

Reviewing the outcomes at each of the stages outlined above, growers will get to know more about actual disease levels on the farm and how their control measures are working. Greater attention at identifying, recording and treating the first few pieces of disease by non-chemical methods can avoid the need to use pesticides at all.

The bottom line is that active involvement in the IPM process is needed from the top down for it to be successful. And it is the combined actions of the sector as a whole that will reduce our reliance on chemical pesticides, resulting in a more environmentally conscious approach to disease control.